

## CLAIMS

1. A method of monitoring the temperature of a transformer winding in a current probe wherein the current probe includes a magnetic core having a multi-turn winding disposed there-around forming a probe transformer and a Hall Effect device disposed within the magnetic core for generating a differential output signal for producing a current signal through the multi-turn winding, the method comprising:

determining an initial transformer temperature of the current probe as a function of the winding resistance of the transformer;

determining a relative temperature of the Hall Effect device as a function of resistance change of the Hall Effect device; and

combining the initial transformer temperature and the relative Hall Effect device temperature to produce a continuous transformer temperature indicative of the temperature of the transformer.

2. The method of monitoring the temperature of a transformer winding in a current probe as recited in claim 1 further comprising the step of removing the current signal from the multi-turn winding when the continuous transformer temperature exceeds a threshold temperature value.

3. The method of monitoring the temperature of a transformer winding in a current probe as recited in claim 2 further comprising the step of providing a visual indication when the continuous transformer temperature exceeds a threshold temperature value.

4. The method of monitoring the temperature of a transformer winding in a current probe as recited in claim 1 wherein the initial transformer temperature determining step further comprises the steps of:

storing the thermal coefficient of copper,  $\alpha$ , an initial transformer temperature,  $T_0$ , and a termination resistance,  $R_{termination}$ , in memory;

generating digital values representative of an input voltage,  $V_{in}$ , to the multi-turn winding and an output voltage,  $V_{out}$ , from the multi-turn winding;

calculating an initial probe resistance,  $R_0$ , using the termination resistance and the digital values of the input and output voltages; and

calculating the initial transformer temperature,  $T_{probe}$ , using the function

$$T_{probe} = T_0 + \frac{1}{\alpha} \left( \frac{R_{termination} (V_{in} - V_{out}) - R_0 V_{out}}{R_0 V_{out}} \right)$$

5. The method of monitoring the temperature of a transformer winding in a current probe as recited in claim 1 wherein the relative temperature of the Hall Effect device determining step further comprises the steps of:

5 storing a thermal coefficient of resistance value of the Hall Effect device,  $\alpha_H$ , a Hall Effect device bias voltage source value,  $V_{Bias+}$ , and a resistance bias value,  $R_{Bias}$ , in memory;

generating a digital value representative of a voltage,  $V_{Hall+}$ , across the Hall Effect device;

10 calculating an initial Hall Effect device resistance value,  $R_{Hall}$ , using the function  $R_{Hall} = \left( \frac{2 \times V_{Hall+} R_{Bias}}{V_{Bias+} - V_{Hall+}} \right)$  and storing the resistance value in memory as

$R_{Hall Init.}$ ;

generating additional digital values representative of the voltage,  $V_{Hall+}$  and calculating Hall Effect resistance values,  $R_{Hall}$ , representing changes in the resistance of the Hall Effect device as a function of temperature; and

15 calculating changes in temperature of the Hall Effect device,  $\Delta T_{probeHall}$ , using the function  $\Delta T_{probeHall} = \frac{1}{\alpha_H} \left( \frac{R_{Hall} - R_{Hall Init.}}{R_{Hall Init.}} \right)$ .

6. The method of monitoring the temperature of a transformer winding in a current probe as recited in claim 1 wherein the relative temperature of the Hall Effect device determining step further comprises the steps of:

20 storing first and second thermal coefficient of resistance values of the Hall Effect device,  $k_1$  and  $k_2$ , a Hall Effect device bias voltage source value,  $V_{Bias+}$ , and a resistance bias value,  $R_{Bias}$ , in memory;

25 generating a digital value representative of a voltage,  $V_{Hall+}$ , across the Hall Effect device;

calculating an initial Hall Effect device resistance value,  $R_{Hall}$ , using the function  $R_{Hall} = \left( \frac{2 \times V_{Hall+} R_{Bias}}{V_{Bias+} - V_{Hall+}} \right)$  and storing the resistance value in memory as

$R_{Hall Init.}$ ;

30 generating additional digital values representative of the voltage,  $V_{Hall+}$  and calculating Hall Effect resistance values,  $R_{Hall}$ , representing changes in the resistance of the Hall Effect device as a function of temperature; and

calculating changes in temperature of the Hall Effect device,  $\Delta T_{probeHall}$ , using the function  $\Delta T_{probeHall} = k_1 (R_{Hall} - R_{Hall\ Init.}) + k_2 (R_{Hall} - R_{Hall\ Init.})^2$ .